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SOME ITEMS IN THE PROGRESS OF ASTRONOMY IN 1931

By H. R. KINGSTON, *Retiring President*

THE year 1931 was an anniversary year. It marked the passing of exactly a century and a half since William Herschel, while searching the skies for everything within reach of his telescope, found on March 13th, 1781, a small body which later proved to be another member of our solar family, the planet Uranus. This discovery was the first of a long series which has continually expanded our astronomical horizons. The discovery of Neptune in 1846 increased again the known extent of our planetary system, and the ninth in the series was found in 1930, when Pluto was added to the solar family. Further evidence is now accumulating to indicate that this series may be not yet complete.

For a long time, the stars in our Galaxy were thought to mark the extent of the universe, but the first quarter of the present century has brought to us so much information about the spiral nebulae and their colossal distances that our Galaxy has now become only one huge system in a vaster universe whose bounds, if they exist, we have, as yet, not compassed. The past year, the one hundred and fiftieth anniversary of the year in which was made the first great discovery beyond the planet Saturn, has been tense with interest in, and active investigation of, this super universe, which is not only colossal in its extent but apparently is also expanding at a terrific rate. Hubble, at Mount Wilson Observatory, has

photographed the island universes at distances of 140 million light-years. Within this distance he finds that there are about two million nebulae which are fairly uniformly spaced at about 1,800 thousand light-years apart. What an advance this is over the reach of our knowledge when we thought of the Milky Way as the bounds of the universe—the Milky Way with its radius, as we now believe, of between 100 and 150 thousand light-years. Our own Galaxy we now know to consist of a vast aggregation of stars and nebulae in the form of a wheel in which the sun is not at the centre but is approximately 1/3 of the way out along one of the spokes of the wheel, and revolving around the hub at about 200 miles per second, taking about 200 million years to make one complete revolution. Sir James Jeans suggests that as a model of the super universe of Galaxies as far as we now know it, we consider apples placed ten yards apart until they fill a sphere a mile in diameter. This will require about 300 tons of apples; each apple is a nebula containing enough material for the creation of several thousand million stars like our sun; each atom in each apple is as big as the giant Betelgeuse with its diameter exceeding that of the earth's orbit, and its volume equal to 27 million times that of our sun or 27 million million times the volume of our earth.

The year 1931 has brought some astounding information about the spiral nebulae. For some time we have known that the spirals have been for the most part apparently receding from our Galaxy at tremendous speeds, but one has been recently found at Mount Wilson to be flying away from us at 15,000 miles per second. Its distance is estimated to be 135 million light-years. The speed of recession has been determined by the shifting of the spectral lines toward the red. An interesting fact that has recently come to light regarding these supposed speeds of recession is that they are approximately proportional to the distances of the nebulae, the velocity increasing by about 105 miles per second for each million light-years of distance. Such astounding speeds greatly tax our credulity and indeed many astronomers and physicists are seriously questioning the validity of ascribing these spectral shifts entirely to the Doppler effect. It may be possible that the spectrum is

affected by the distance through which light has travelled through space, *i.e.*, the shifting of the spectrum may be a function of the distance itself as well as of the speed of recession. If, however, the effect is due to speed alone, the universe must be expanding or flying apart at a terrific rate. Eddington has calculated that the universe started with a radius of about 1,200 million light-years, which has now increased to about eleven times this initial value and appears to be doubling every 1,400 million years. From this the age of the universe would be about 10,000 million years at most. But here we meet a difficulty. Lemaitre and Eddington suggest that the spiral nebulae may have condensed out of a great uniform cosmic nebula and this condensation may have started the expansion. The time required for this and the time needed for binaries to break apart and recede to the great distances at which many of them revolve around each other, seem to be much greater than 10,000 million years, indeed, some millions of millions of years appear to be necessary for this evolution.

The solution of this problem, the bearing upon it of the "cosmic rays", and the source of the latter have provoked, during the past year, and are still provoking, the keenest thought and discussions by the leading astronomers and physicists of our day, as was shown, for example, at the 1931 meeting of the British Association for the Advancement of Science. In regard to the cosmic rays, Jeans believes they arise from the annihilation of matter and that the universe is by this process gradually having its mass changed into energy or radiation which, in turn, is being used up in doing, by light pressure, the work of expanding the universe. Hence, mass is being turned into mere bigness with finally zero content—the universe is running down. On the other hand, Millikan maintains very strongly, on the basis of experiment as well as theory, that the cosmic rays are generated by the actual formation of matter and that the universe is therefore building up instead of running down. De Sitter believes that the expansion of the universe on one hand and the evolution of stellar systems and stars on the other, are two different processes taking place side by side but without any apparent connection between them, and that the expansion has

been going on only during an interval of time which is exceedingly brief as compared with the duration of the evolution of the systems in the universe. But we must remember that these suggestions are largely theories and may or may not contain the actual truth of the matter. Possibly a satisfactory solution of this problem may be found in the near future and it may provide a key to the structure of the universe as a whole.

For some time we have considered that our Galaxy held an outstanding position among the island universes in that it was four or five times larger than the greatest other known nebula. The size has been determined from the period-luminosity law of the Cepheid variables immersed in the globular clusters, which appear to mark the bounds of our Galaxy. Dr. Seares, assistant director of Mount Wilson Observatory, infers from photographs of the Milky Way that clouds of dust and gas in the plane of the Milky Way dim the light of these clusters and thus make them appear farther away than they really are. Professor Carpenter of Steward Observatory, University of Arizona, was led to the same conclusion by comparing the brightness and size of spiral nebulae at various distances from the pole of the Milky Way. He found that a nebula of given size near the Milky Way is fainter than one of the same size near a Galactic pole. At twenty degrees from the Milky Way, where we should be looking through three or four times as much material as in the direction of the Galactic poles, if such material exists, the brightness of nebulae is forty per cent. less than in the case of those near the Galactic poles. If this result is due to absorbing material throughout the Galaxy, the distances in the plane of the Milky Way, as formerly determined by the apparent brightness of stars, are much too great. Evidence of this apparent absorption of light in interstellar space has been found also by several other astronomers. If the above be true, our estimates of the size of the Galaxy must be reduced and it may be that the Milky Way will prove to be of about the average size of the spiral nebulae. This would be further evidence indicating that our Galaxy is typical of spiral nebulae and that we may therefore gain information about it by studying the latter. Probably, if we could observe our Galaxy

from a distance of one million light-years, it would appear much like the Nebula in Andromeda or Messier 33 in Triangulum, with great star clusters, luminous nebulae and dark obscuring clouds scattered among the great aggregations of stars.

It has been suggested that on the hypothesis of the curvature of the universe, some pairs of nebulae observed in opposite directions may be single nebulae seen from both sides, the light having travelled from the nebula to us both ways around the universe. Lemaître says, however, that light from objects over 28 million light-years away would have its shortest waves so greatly lengthened as to make them invisible in the infra-red. If this is true, it would make impossible these "ghost images" of nebulae made by light that has travelled around the universe the other way.

During the past year, the world lost one of its outstanding scientists, namely, Dr. Michelson of the University of Chicago. In 1926 by measurements on light travelling 22 miles between Mount San Antonio and Mount Wilson, he found the velocity of light to be 186,290 miles per second. This he believed to be correct to within about three miles per second, but he set to work again to improve on this measurement. He had constructed on a ranch near Pasadena, a mile-long, air-tight tube three feet in diameter from which practically all the air was exhausted—only 125 cubic feet at ordinary atmospheric pressure remaining. By passing light through this tube, he hoped to obtain such an exact value for the speed of light that it would be possible to use this speed as a measuring-stick in precise surveying. With this consummate attainment, Dr. Michelson hoped to crown his life's work. Unfortunately, death intervened before the completion of the experiment, but the work is being carried on by his associates.

In this connection, it is interesting to note a statement by de Bray, who says that the speed of light seems to be decreasing, as is indicated by the following measurements:

In 1902 Perrotin found the velocity to be 299,895 km. per second.

In 1924 Michelson found the velocity to be 299,802 km. per second.

In 1926 Michelson found the velocity to be 299,796 km. per second.

In 1928 in Germany the velocity found was 299,778 km. per second.

The suggestion is made by de Bray that this may be due to the changing intensity of the earth's magnetic field.

The past year has witnessed some interesting discoveries regarding individual stars. At the June meeting of the Royal Society, the announcement was made that Dr. J. A. Pearce of the Dominion Astrophysical Observatory at Victoria had discovered the greatest double star yet measured. Its mass is 184 times as great as that of the sun, one component being 134 times as massive as the sun and the other 50 times as massive. The period of this giant system is 56 days.

Mr. H. van Gent of the Leyden Observatory, discovered, at the Union Observatory at Johannesburg, a star in Argo, which has the shortest known period of variation, namely, 100 minutes. The usual period is at least several days. This star at its brightest is of the fourteenth magnitude and at minimum is about one magnitude fainter. It is so faint that it requires about half an hour to photograph it, and in that time its brightness changes considerably. Its period was determined, therefore, by visual observation with a telescope.

As is well known, no star has ever shown a disc even in our greatest telescopes. However, Professor Nakamura at Kyoto, Japan, in observing an occultation of Antares by the moon, noticed that it required an appreciable time, at least a tenth of a second, for Antares to attain full brilliancy as it emerged from behind the moon. The diameter of Antares is known from measurements with the interferometer to be four one-hundredths of a second of arc and it would take the moon approximately one-tenth of a second to move over this angle. This is the first time, I believe, that a star's disc has been revealed by a visual observation. Evidently only very large stars could show this.

A phenomenon which has long puzzled astronomers is the presence of bright lines which appear in the spectra of B-type stars.

Dr. Otto Struve of Yerkes Observatory suggests that these may be caused by the presence of nebulous rings which have been formed around these stars because of their rapid rotation. A gaseous body in rapid rotation may become lens-shaped and eject matter at the equator. This matter would revolve around the star as do Saturn's rings, and would produce bright lines in the spectrum. When the plane of rotation passes through our solar system, the bright lines produced by this ring would be double since one edge of the ring would be moving toward us and the opposite edge away from us. If the plane of rotation were perpendicular to the direction of the star from us, the lines would, of course, be single.

But it is not only with the Milky Way and beyond that the astronomers have been engaged in research. Our own solar system still presents many challenges to the investigator. Astronomers at Mount Wilson have been studying Neptune's satellite and have been successful in determining its approximate mass which lies between one tenth and one twenty-fifth of the mass of the earth. This mass was obtained by considering the oscillation of Neptune due to the fact that it and its moon revolve around their common centre of gravity.

Pluto still continues to receive a great deal of attention. Pluto is now, without question, a planetary member of our solar family and its orbit is well determined, and while its mass and size are believed to be somewhat of the orders of those of the earth, a considerable period of observation will be necessary to determine these accurately. The average temperature is about the order of that of liquid helium, *i.e.*, about $-450°$ F.

The sun continues to receive intense investigations. Dr. S. A. Mitchell, Director of Leander McCormick Observatory, has found in the spectrum obtained at Niafou Island at the October, 1930, eclipse, a new line of coronium at wave-length number 6776, toward the red end of the spectrum.

For the first time, the sun's corona has been observed without an eclipse. Lyot, of Paris, has traced the form of the corona by polarized light. The observations were made from an altitude of 9,439 feet and are possible only when the air is very clear. The

light is polarized by reflection from the tiny particles of the corona. This polarized light is revealed by a polarimeter which is so sensitive that it will detect one part of polarized light in a thousand parts of ordinary light. By means of this instrument, Lyot claims he can trace the corona, and also the prominences, out to one-fifth of the sun's diameter.

Dr. Harlan Stetson, Director of Perkins Observatory, Delaware, Ohio, has continued his study of the connection between sun-spot activity and radio reception. He finds that long-distance reception varies with sun-spot activity, being better when the spots are fewer. On this basis, his predictions for several years, of the quality of radio reception, have been very largely fulfilled. With sun-spots now getting fewer, Stetson predicts greatly improved radio reception this winter.

Dr. Abbot of the Smithsonian Institution has continued his investigations of the records of sun-spots, of variations in the sun's radiation and of various other solar phenomena, in the hope of establishing a correlation between these and terrestrial weather cycles, which may make possible long-range weather forecasting. This question is being investigated also at the Dominion Observatory at Ottawa.

The year 1931 marked an important event in the near-visit paid us by the planetoid Eros. This tiny object, discovered in 1898 by Witt, of Berlin, is of great interest to astronomers because it is the best heavenly body yet known for enabling us to obtain the solar parallax, or the sun's distance. Since, moreover, when the distance of one planet or planetoid is known, the distances of all the others are readily found, it is seen how important it is to obtain accurately the distance to one of the sun's family. The planet Mars has been used for this purpose with fair success, but its red colour, its disc, and its comparatively great distance even at its nearest approach to the earth, all combine to prevent it from being the most desirable object for this purpose. On the other hand, Eros is a tiny object, is practically pure white, and sometimes comes much closer to us than Mars ever does. The closest approach of Mars is about 35 million miles, while Eros may sometimes come within 13,800,000

miles of us. These visits of Eros occur once in 30 years. In 1900 Eros came within 30 million miles. Hundreds of observations were made on this object on that occasion and from these were found the most accurate value of the solar parallax that has ever been determined. In 1931 Eros again visited us, coming this time within about 15½ million miles of the earth on January 30th. On this visit an elaborate programme of observations was carried out by many observatories, the results of which should, when finally brought together, provide us with a very accurate value of the solar parallax.

Previous to this year, Eros has been visible only as a pin-point of light without any measurable disc, but on this occasion two astronomers at Johannesburg have been able to see that Eros is not an oblate spheroid like the planets but an ellipsoid from 25 to 29 miles long and from 8 to 10 miles in average width.

The light of Eros has been known to be variable and it was thought that this was caused either by the shape of the body or by different reflecting powers of various parts of its surface. It is now known that it is the shape of Eros which causes its variability. The period of its light variations is 5 hours 16 minutes and 12.94 seconds. As one side is turned towards the earth, the intensity increases, then falls as one end turns toward us, increases as the other side comes into view, and then falls as the other end appears.

During 1931 two new comets were discovered. On July 15th, Nagata, a Japanese gardener in California, discovered a comet with his 3-inch telescope. This comet was never visible to the naked eye. It was the first comet discovered in 1931 and Nagata was hence awarded the Donohoe Comet Medal of the Astronomical Society of the Pacific.

In August, Ryves, another amateur astronomer, discovered a new comet near the position where Nagata's comet was first seen. Ryves' comet was bright enough to be visible to the naked eye but was close to the sun.

The Schwassman-Wachmann Comet was observed at a distance of more than six times the sun's distance and it is thought that it may be observed entirely around its orbit. Its path is nearly circular

and lies between the orbits of Jupiter and Saturn. It will be at aphelion in about two years. Early in 1931 it suddenly increased in brightness one hundred fold in a few days, but still at its brightest it is only of the twelfth magnitude.

The past year was fortunate in experiencing a fine shower of the Leonid meteors. These meteors have a period of about 33 years. In 1799 and 1833 they were very spectacular, the whole sky being covered with these flashing bodies. But in 1866 and 1899 they were increasingly disappointing. While the 33-year period is not complete till 1932, there was a splendid display last November. One of my students, Mr. Hugh Dowker, of Parkhill, observing at London, Ontario, counted 197 meteors between 12.30 a.m. and dawn. "Fifteen or twenty of these", he states, "were bright enough to light up the ground around me. Quite a number left bright trails behind them, some of which lasted over a minute. The fast ones that went straight overhead left a trail of sparks, mostly brilliantly white, a few, however, being yellow and red. One exploded with a purple colour". Many observers counted several hundred. In one case a party used an aeroplane to view the shower.

The main condensation of the Leonid swarm requires about three years to pass the point where the earth's orbit crosses the Leonid stream. Sometimes, apparently, we miss the central part of the swarm and catch only the ends of the condensation. The greatest display will probably occur on the evening of November 16th and the early morning of November 17th, 1932. We trust that it may be as spectacular as the display in 1833, when it was estimated that 200 thousand per hour were observed for five or six hours. "The sky was as full of them as it ever is of snowflakes in a storm", and "looked like a gigantic umbrella", according to witnesses. What a sight this would be!

Mention should be made also of the Perseid shower in 1931. Many who watched the skies on the early morning of August 12th were rewarded by seeing a very interesting display.

The past year has witnessed great activity in the construction of new telescopes. The new 69-inch reflector for Perkins Observatory is nearing completion. The mirror was made at the

Bureau of Standards at Washington. This is the first large mirror to be constructed entirely in America. Formerly all our large discs came from the St. Gobain glass works in Belgium. The Perkins Observatory mirror has undergone rigid optical tests, in which Dr. Plaskett of Victoria collaborated, and has been pronounced satisfactory. It was figured to the mathematically determined curve with an accuracy of one millionth of an inch. The mounting is ready and it is hoped that the telescope will be in operation in June of this year.

The construction of the great 200-inch telescope for the California Institute of Technology has been in the experimental stage during the past year and a successful casting has not yet been obtained. It is estimated that over 1,500 million stars should be accessible with this telescope and its photographic attachments, *i.e.*, one star for each man, woman, and child in the world to-day. When used under favourable conditions, this new telescope will bring the moon within the apparent range of twenty-five miles, and if its theoretical power of resolution is actually realized, it will make possible the detection of two luminous points on the moon separated by only 30 feet.

Here in Toronto the year 1931 has been important in regard to the progress that has been made in connection with the great Dunlap Reflector. This is to be 74 inches in diameter. The astronomical world will be greatly enriched by this wonderful addition to its working equipment and along with the citizens of Toronto, and indeed also with the people of our whole Dominion, will be placed under a very great and lasting debt to Mrs. Dunlap for this magnificent gift. We all join in congratulations to Dr. Chant, Dr. Young, our new President, and their associates as they look expectantly forward to the completion of this instrument and the observatory, the consummation of a life's dream.

Then, also, there has been projected during the past year the new 40-inch telescope to be built for the U.S. Naval Observatory. It has been invented by Professor Ritchey, who designed the 100-inch telescope at Mount Wilson, and Professor Chrétien of Paris. Professor Ritchey claims that it will be superior to the 100-inch.

It will be only 10 feet 4 inches long. Instead of a solid mirror, the reflector will be made from thin plates of glass cemented together to make the rigid surface. This will be supported on a light, ribbed honeycomb structure which will allow free ventilation of the mirror. Dr. Ritchey claims that mirrors up to 30 feet in diameter can be made in this way. The telescope will use special photographic plates with a concave form true to one fifty-thousandth of an inch; the emulsion will be ten times as thin as that now used and the granulation of the silver bromide particles will be 12 times finer. In this instrument rays can be brought to a sharp focus over the entire plate. It will be possible to focus with an accuracy of one ten-thousandth of an inch instead of one one-hundredth of an inch as at present. The cost will be much less and the ease of operation much greater, Professor Ritchey claims. We shall all look forward with interest to the outcome of this experiment.

We should not close even this very sketchy review without mentioning a development of the past year which is, or will soon become, of great and very general interest. I refer to the progress that has been made towards the adoption of a new calendar. Everybody is interested in, and affected by, the calendar. Before the time of Julius Caesar, a lunar calendar was used, the moon's period of 29½ days from new moon to new moon being the unit. Twelve "moonths" or months of alternately 29 and 30 days constituted a very crude approximation to the year. The extra 11 or 12 days necessary to complete the year were taken into the reckoning by intercalating a month or sometimes two or more months as suited the political whims of those in control. This resulted, of course, in great confusion. This first stage of calendar development ends with Julius Caesar who, on the advice of the Alexandrian astronomer, Sosigenes, inaugurated, in 45 B.C., the second stage in calendar evolution, a stage in which the moon played no part at all. The months contained, under the new arrangement, 30 or 31 days, with the exception of February, from which one day was taken and added to July to honour Julius. This calendar year was now 365 days long, and an extra day was added each fourth year to make the average length of the year 365¼ days. To keep up with Uncle

Julius, Caesar Augustus took another day from February and added it to August, leaving February 28 days except in leap year when it had 29. This second stage lasted until 1582, when Pope Gregory XIII brought the calendar, which had by that time fallen eleven days behind the sun, up to date by skipping eleven days and changing the leap year rule by dropping the counting as leap years of those even century years not exactly divisible by 400. Thus the third stage begins, and the calendar will now keep step with the sun to within one day in 3,300 years. This Gregorian Calendar was not adopted by England till 170 years later (1752).

At the present time, we are probably nearing the end of this third stage of calendar history. With agriculture giving place to manufacturing as the principal industry in many countries of the world, with the consequent employment of vast numbers of persons in single industries and with the increasing complexity and competition of industrial life, it is becoming more and more necessary in cost accounting to equalize the number of working days in the months, in the quarters and in the half-years. Also, it seems desirable, if not absolutely essential in our ordinary life, that the lengths of the months be more regular and that the calendar be perpetual, that is, that the years all begin on the same day of the week and also that any particular date always fall on the same day of the week.

To effect these results, a great many calendars have been suggested during the past few years, but up to a year or two ago, a thirteen-month year, with 28 days in each month, was the one which seemed to offer the best solution. This was sponsored by a Canadian, Mr. Cotsworth. In this calendar each month contained exactly four weeks, the thirteen months thus making 364 days. To make the calendar perpetual, the 365th day was to be a universal holiday and not count as any week-day. This day was to be added after December 28. In leap year, another such day would be introduced, probably near the middle of the year. This is a very simple arrangement and makes all the months exactly alike in all years. However, the fact that 13 is not integrally divisible into halves or quarters or thirds (for Spanish speaking countries) militates very

strongly against the adoption of such a scheme. The matter came before the League of Nations and was referred to the various governments for recommendations which were to be presented to the League in October, 1931. During the past year or more, a great deal of opposition to the 13-month arrangement crystallized because of the difficulty mentioned above, also because of the increased labour and cost in preparing 13 monthly business statements each year instead of 12, and because of the fact that many dates would be considerably changed, those near the middle of the present calendar year being shifted by half a month; thus the 30th of June by the present calendar would be about the 15th of Sol by the 13-month calendar, Sol being the new month to be added between June and July. There were also several other objections, not overlooking, of course, the widespread feeling or superstition about the number 13 itself.

Another suggestion was sponsored by the World Calendar Association, according to which the year would retain 12 months of four identical quarters, each quarter having 3 months of 31, 30 and 30 days respectively. January 1st would come on Sunday, February would start on Wednesday and March would begin on Friday and end on Saturday. Then April, May and June would merely repeat January, February and March, and likewise the two quarters, July, August, September, and October, November, December. This would take care of 364 days. The 365th day would be an international holiday following December 30th and would not have any week-day name. Similarly in a leap year, an extra holiday—not to count as any week-day—would be put in, probably after June 30th. This calendar is very simple. It retains that most desirable number of months, namely 12, is perpetual, every month has exactly 26 working days, the quarters are exactly equal, the half-years likewise, and, moreover, no dates in the present calendar would be shifted more than one day either way by the introduction of this plan. This calendar could be introduced in 1933 without any disturbance of week-days, since that year begins on Sunday.

When the matter came before the League of Nations, in October last, it was found that only two delegates had been specifically

instructed by their governments to support the 13-month plan. These countries were Canada and Yugoslavia. In very few cases were the delegates actually instructed by their governments to support any particular scheme, but the reports indicated a strong opposition to the 13-month plan and a general sympathy for some 12-month arrangement. No particular plan was actually sponsored by the League, as it was felt that the public was not yet sufficiently acquainted with the various plans to judge their values accurately. Hence, the matter was referred back again to the various governments. The meeting of the League did, however, serve to stimulate interest in the problem and to disseminate a great deal of information regarding the essential requirements in a reformed calendar and regarding the degrees to which the plans submitted realized these needs.

The League did, however, support the stabilization of Easter, that is, the placing of it on a definite Sunday, as, for example, the first Sunday after the second Saturday in April. This question had been considered by the great religious bodies of the world, and altogether the stabilizing of Easter had been very generally approved. This matter is quite independent of any general calendar reform, but, unless a perpetual calendar is adopted, the date of Easter Sunday would still wander over seven days. In this connection it should be noted that England has already passed an act by which she will put the new Easter into effect as soon as it is adopted by other nations. Similar action by England or any other leading nation in regard to a 12-month calendar plan such as the one described above would be a very effective forward step in calendar reform.

It is felt that public opinion will not be ripe for any change in 1933, and hence, if this "World Calendar", as it is called, is to be adopted, its inauguration would have to be delayed till 1939 to avoid any adjusting of week-days in starting the year on Sunday.

In the meantime, another calendar has been proposed by a Mr. Parmelee of Chicago, which is essentially the same as the World Calendar but begins the year on Monday (and hence could be introduced readily in 1934) and gives January, February and March

30, 30 and 31 days respectively, and repeats this for each of the other quarters. It really accomplishes exactly the same results as those mentioned above for the world calendar. In each of these calendars, Christmas, for example, on December 25th, would always come on Monday. This would give a happy week-end for this occasion.

The increased interest that is being shown in calendar reform as the public learns more and more of the advantages and simplicity to be gained, makes the adoption of some new scheme at a fairly early date almost certain, and it is probable that one of the two twelve-month plans mentioned above will be chosen.

Now, after this brief review of 1931, let us take one peep ahead into 1932. We are all interested in the total solar eclipse of August 31st next. The westerly edge of the path of totality passes just west of Montreal, while the easterly edge passes about midway between Three Rivers and Quebec City. The path is thus about 100 miles wide. The duration of totality on the centre line is approximately 100 seconds in the Province of Quebec. The eclipse occurs in mid-afternoon and the chances of a clear sky in Quebec at that time are about 50%. Many observatories are planning to send parties to the eclipse path. Dr. Chant and Dr. Young are preparing to study the eclipse at St. Alexis, 60 miles north-east of Montreal. A party from Greenwich is planning to observe at a station on or near Lake Magog. The Royal Astronomical Society is working on plans for observing the eclipse in co-operation with the various centres of the Society. Mr. J. R. Collins is chairman of our eclipse committee.

It has been suggested that it may be possible, by television, to make the eclipse visible to people outside the path of totality. Moreover, if the weather should be cloudy, a party in an aeroplane might fly above the clouds, get a perfect view of the eclipse, no matter what the weather was below, and broadcast the pictures so that all who "listen in" may "see" this marvellous sight themselves. Thus does man take another step forward and roll back the map of the impossible.

ANNUAL GENERAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

The meeting was held in the Physics Building of the University of Toronto at 8 p.m. Tuesday, January 19, 1932. Dr. R. K. Young, vice-president, in the chair.

The minutes of the Annual Meeting of 1931 as printed in the JOURNAL for March, 1931, were confirmed.

The General Secretary, Prof. Lachlan Gilchrist, presented the reports of the Secretaries and Treasurers of the various centres. These were accepted and approved for publication.

The Financial Report was presented by Mr. J. H. Horning, the General Treasurer. Moved by Mr. J. R. Collins, seconded by Dr. J. B. Fraser, that the report be received. (Carried.)

The Curator's Report was presented by Mr. R. S. Duncan, and received. The Librarian, Mr. R. A. Gray, presented a report, which was adopted. The scrutineers announced that the ballots were almost unanimously in favour of those named on the ballot, and the Chairman therefore declared the following officers duly elected for 1932:

Honorary President—R. M. Stewart, M.A., F.R.S.C., Ottawa.
President—R. K. Young, Ph.D., Toronto.
First Vice-President—Mgr. C. P. Choquette, M.A., Lic. Scs., Montreal.
Second Vice-President—Lachlan Gilchrist, M.A., Ph.D., Toronto.
General Treasurer—J. H. Horning, M.A., Toronto.
General Secretary and Librarian—R. A. Gray, B.A., Toronto.
Curator—R. S. Duncan, Toronto.
Council—D. S. Ainslie, M.A., Ph.D., Toronto; F. Napier Denison, Victoria; Miss A. Vibert Douglas, Ph.D., Montreal; R. E. DeLury, M.A., Ph.D., Ottawa; E. A. Hodgson, M.A., Ottawa; A. R. Hassard, K.C., Toronto; J. A. Pearce, M.A., Ph.D., Victoria; J. Patterson, M.A., Toronto; John Satterly, M.A., D.Sc., Toronto; L. A. H. Warren, M.A., Ph.D., Winnipeg.

The thanks of the Society were expressed to the auditors, and they were requested to act again for the coming year.

Some discussion took place with regard to housing the library properly, also the question of insurance on the books was brought up, and the treasurer was instructed to put it on the agenda for the next Council meeting.

E. J. A. KENNEDY,
Recorder.

MEMBERSHIP OF THE SOCIETY

The membership of the Society on December 31, 1931, as shown by the reports of the different Centres, was as follows:

	1931	1930
Toronto	174	164
Ottawa	64	67
Victoria	118	117
Montreal	115	114
Winnipeg	47	46
London	70	52
Hamilton	40	82
Members at Large	104	96
	732	738

	1931	1930
Honorary Fellows	10	10
Life Members	16	15
Subscribers to JOURNAL	64	64
	90	89

E. M. BUDD,
Assistant Secretary.

LIBRARIAN'S REPORT

During the year 1931 exchange publications similar to our JOURNAL, and to the HANDBOOK continue to arrive at the library in large numbers. These publications are world-wide, ranging from China and Japan to our neighbour to the immediate south of us. Requests for new exchanges have recently been made by ob-

servatories in various countries and it is to be regretted that some have to be declined.

The members of our Society are recommended to make use of the library more fully than they now do. Many books of a popular character have found a place on the shelves and are available to all members whether residents of Toronto or not, and there are many readable articles in the exchange publications of a popular nature which furnish up-to-date information and are of real interest.

The Assistant Librarian's report is attached herewith.

The number of periodicals received during 1931:

From Canada and the Empire	194
From the United States	190
From other countries	226
Total	610

The Exchange list was given in the March JOURNAL.

The number of books added to the library by purchase was 7.

The number borrowed by members was 68, also volumes of periodicals were several times loaned to other libraries.

R. A. GRAY,
Librarian.

CURATOR'S REPORT

There have been a number of applications for lantern slides. Some weeks ago a selection was sent out to Saskatchewan where, I believe, a number of talks were given in various towns. A member in Owen Sound recently made enquiry regarding the borrowing of slides.

The Cooke telescope has been in use all year, and the Larratt Smith telescope during the summer months.

Our collection of lantern slides has become somewhat thinned out through losses and damage and few if any additions have been made in years. I would recommend that our collection should be revised and brought up to date.

ROBT. S. DUNCAN,
Curator.

Reports of the Secretaries of Centres

Toronto

During the year 1931 we have held thirteen meetings as follows:

Jan. 27—Star Clusters, by Dr. R. K. Young.
Feb. 10—Recent Geophysical Investigations in Mineralized Regions, Prof. Lachlan Gilchrist.
Feb. 24—Telescopes for Amateurs and how to Use them, J. A. Marsh, Hamilton.
Mar. 10—The Energy of the Sun, Prof. D. S. Ainslie, Ph.D.
Mar. 24—The Stars in Navigation, Commander J. N. de Marbois.
Apr. 14—Some Mathematical Parodoxes, Prof. S. Beatty, Ph.D.
Apr. 28—The Nebulae outside the Galaxy, Prof. H. H. Plaskett.
Oct. 6—Pluto, the Ninth Planet, Prof. C. A. Chant.
Oct. 20—Some Little-known Cosmic Theories of Newton. Members' discussion.
Nov. 3—How the Distances of the Stars are Determined by Cepheid Variables, R. A. Gray, B.A.
Nov. 17—The Tides. Discussion by members.
Dec. 1—Toronto's great Engineering Feat, the new Waterwork's Tunnel, Wm. Gore, C.E.
Dec. 15—Double Stars, R. A. Gray, B.A.

During the fall season now closing we have tried the experiment of having every alternate meeting for members only. It was the thought of the programme committee that a meeting non-public in character might induce a more informal discussion on astronomical subjects. The committee invited questions in writing by the members before the meeting and they undertook to have them answered by those qualified and thus raise a discussion. The response has been disappointing; the meetings, however, have been quite enjoyable and helpful.

We started the year with a membership of 164; new members elected, 22; resignations, 11; transferred to London Centre, 1; leaving our present membership, 174.

This is a rather unfavourable feature of the report and should be carefully considered by the Toronto members. It is of interest to know that most of the Centres of the Society are increasing in membership yearly; we would like to appeal to every member to endeavour to interest others in the Society and its advantages. Greater numbers mean increased revenue, and increased revenue would enable us to bring speakers from a distance. Toronto

Centre has four observational committees at work, we expect to have separate reports presented to the Society from these at different dates during the season.

E. J. A. KENNEDY,
Secretary.

OTTAWA

During the year 1931, five public lectures were given by the Ottawa Centre in the lecture hall of the Victoria Memorial Museum as follows:

Jan. 30—Navigation and Astronomy, by Prof. T. H. Matthews, M.A.
Mar. 27—Methods of Geophysical Prospecting, by Dr. Lachlan Gilchrist and Mr. A. H. Miller, M.A.
Oct. 23—Learned Societies for the Unlearned, by J. S. Lane, B.A.
Nov. 13—Astronomical Periods in Climate and Life, by Dr. Ralph E. DeLury.
Dec. 17—The Art of Pathfinding, by R. Glenn Madill, B.A.

In addition to these two regular council meetings were held at the Dominion Observatory.

The membership of this Centre now stands at 64, a decrease of three from last year. One member, Dr. H. M. Ami passed away during the year, and two members have resigned.

The custom was continued of sending the various issues of the Saturday evening programmes published by the Dominion Observatory, to the members.

MIRIAM S. BURLAND,
Secretary.

MONTREAL

During the past year (November 1930—April 1931) five regular meetings were held in the Macdonald Physics Laboratory, McGill University, as follows:

Nov. 6, 1930—Geophysics at the Dominion Observatory, Mr. R. Meldrum Stewart.
Dec. 4, 1930—Navigation and Astronomy, Prof. T. H. Matthews.
Jan. 29, 1931—The Solar System and its Origin, Dr. N. B. MacLean.
Mar. 12, 1931—The Nebulae, Prof. A. H. S. Gillson.
Apr. 30, 1931—Stellar Spectroscopy, Prof. H. H. Plaskett.

Seven new members were elected and six have either resigned

or been struck from the list on account of two years non-payment of fees. The membership now stands at 115.

A. VIBERT DOUGLAS,
Secretary.

WINNIPEG

During the year 1931 there were held seven regular meetings, all of which were open to the public and were well attended.

Jan. 14—Meteorites, Prof. V. W. Jackson.
Feb. 11—Physics of the Stars, Prof. Frank Allen.
Mar. 11—Colour in Astronomy, Right Rev. T. W. Morton.
Apr. 8—Members' Night—Ten-minute talks:
April Stars, Mr. A. W. Megget.
Atmosphere and Radio, Mr. D. R. P. Coats.
Our nearest neighbour, The Moon, Mr. Jas. Houston.
Algol, Mr. J. H. Kolb.
Oct. 11—Reminiscences of an Amateur Astronomer, Mr. A. W. Megget.
Oct. 11—The Work Entailed in the Grinding, Polishing and Silvering of a six inch Mirror, Mr. D. R. P. Coats.
Nov. 11—The Milky Way and Beyond, Dr. L. A. H. Warren.
Dec. 9—The Evolution of the Telescope, Dr. N. J. Maclean.

There was one meeting of the executive, which was held on April 8th.

On May 14 a special meeting was held when Dr. J. S. Plaskett, F.R.S., gave an illustrated address to the members of the Scientific Club and the Society. "The Structure and Rotation of the Galaxy" was the title of the address.

On May 15 the Society arranged a luncheon at the Hudson's Bay Co. in honour of Dr. and Mrs. J. S. Plaskett, to which the members of the Scientific Club were invited.

It is with deep regret that we record the names of valued members who passed away during the year: Mrs. C. E. Bastin; Mr. Cecil Roy; Mr. J. A. Walker.

Observation meetings were arranged at different times during the season and, with Mr. Megget as leader, proved very interesting and of great educational value.

Ten new members were elected during the year, but the Centre suffered a loss of nine.

S. C. NORRIS,
Secretary.

London

During the year 1931 the Centre held nine regular meetings, with a total attendance of 470.

Jan. 9—Inside Constellation Study, T. C. Benson; Book Review, Miss N. Morris; Demonstration of Spectroscope, F. H. Coates; Lecture, The Milky Way and Beyond, Dr. H. R. Kingston.

Feb. 13—Book Review, Dr. H. S. Wismer; Games, music and refreshments, under the direction of Mr. J. C. Middleton (at home of Mr. Middleton).

Mar. 13—Outside observations, T. C. Benson; Book Review, Dr. H. S. Wismer Lecture, Recent Investigations in the Aurora Borealis, Dr. R. C. Dearle; Demonstration of the Auroral Effect, Gar Elson, M.A.

Apr. 10—Outside observations, with the telescope, directed by Dr. H. R. Kingston; Book Review, Mrs. S. J. Berry; Lecture, Calendar Reform, Major E. H. Anundson; Demonstration of the Photo-Electric Cell, Mr. F. H. Coates.

May 8—Outside observations, T. C. Benson; Book Review, Miss A. E. Henderson; Explanation of the theory of the refracting and reflecting telescopes, with demonstrations, F. H. Coates; Lecture, Applications of Astronomy to Navigation, Captain L. F. Hansen.

June 13—Annual Picnic at Kilworth; Demonstration of the Sun-dial, Mr. F. H. Coates; Observations with telescope, directed by Dr. H. R. Kingston.

Oct. 9—Description and demonstration of the Engineer's Transit, Prof. G. H. Reavely; Lecture, Astronomical Facts of the Great Pyramid, F. H. Coates; Inside Constellation study and outside observations, conducted by T. C. Benson.

Nov. 13—Lecture, The Ice Age, Prof. G. H. Reavely; Demonstration of the Optical Range Finder by Mr. F. H. Coates.

Dec. 11—Annual meeting. Dinner and election of officers. Attendance 37.

The membership of the London Centre for the year 1931 was 70, one of whom, Miss Edith McMechan, died on August 6th.

G. R. Magee,
Secretary.

Victoria

On January 1, 1931, the membership was 117. During the year 10 new members were elected, namely, Rev. W. P. Chapman, A. H. Sutherland, R. L. Whitney, Mrs. E. A. Harvey, E. M. Worth T. Chapman, Rupert F. Warren, W. F. Holdridge, Lt.-Comdr

H. R. Tingley, George Carter. There were 5 resignations and 4 lapsed memberships, leaving a present membership of 118.

There were three council meetings, several observational meet ings during the summer, and eight regular meetings as follows:

Jan. 27—The Aurora Borealis, Dr. G. M. Shrum.
Feb. 24—Reminiscences of some Famous Astronomers, Dr. J. S. Plaskett.
Mar. 24—Some Geological Notes on Vancouver Island — Canada's Most Westerly Mountain Range, Rev. Robert Connell.
Apr. 28—Symposium: Life in the Universe, Dr. J. A. Pearce, Capt. J. H. Hughes H. Boyd Brydon, N. C. Stewart.
Aug. 27—Astronomical Instruments, R. M. Petrie, M.A.
Sept. 29—Symposium: Finding the Distances of the Stars, James Duff, P. H. Hughes, Dr. Frank Hogg.
Oct. 27—The Astronomy of the Poets, W. E. Harper.
Nov. 24—(Annual Meeting)—Distant Universes, Dr. C. S. Beals.

P. H. HUGHES,
Secretary.

FINANCIAL STATEMENT OF GENERAL TREASURER

GENERAL ACCOUNT

RECEIPTS, 1931

Cash in Bank December 31, 1930	$ 522.85	
Grant from Dominion Government	2,000.00	
Grant from Provincial Government	600.00	
University of Toronto (75 Journals)	150.00	
Publications (Journals and Reprints)	204.29	
Southam Press Fund for Astronomical Articles	765.00	
Fees of Members	1,444.70	
Postage Refund (Toronto Centre)	14.92	
Bank Interest	38.61	
		$5,740.37

DISBURSEMENTS, 1931

Publication Journal and Handbook		$2,540.51	
Library Books and Binding		64.20	
Salary, Assistant Librarian		660.00	
Stationery and Stamps		250.76	
Rent, Office and Library		120.00	
Janitor and Caretaker		15.00	
Refund City of Toronto Grant to Toronto Centre		100.00	
At Home and Public Meetings Expenses		82.15	
Gold Medal of Society		25.00	
Telephone (Editor)		20.40	
Southam Press Fund, Dominion of Canada Bonds		1,290.40	
Grants—Victoria Centre	$ 98.00		
Winnipeg Centre	31.50		
Montreal Centre	105.50		
London Centre	53.00		
Hamilton Centre	65.50		
Toronto Centre	152.50		
		506.00	
Miscellaneous Expenses		4.85	
Bank Balance		61.10	
			$5,740.37

LIFE MEMBERSHIP ACCOUNT

Receipts

Balance, December 31, 1930	$ 225.00	
Membership Fee	25.00	
Bond Interest	5.00	
Bank Interest	6.47	
Balance in Bank Account 4390		$ 261.47

BUILDING ACCOUNT

Receipts

Balance, December 31, 1930	$ 858.35	
Interest on Bonds	155.00	
Bank Interest	26.66	
		$1,040.01

Disbursements

Safe Keeping Bonds	2.00
Balance in Bank Account 4383	$1,038.01

MEMO OF BONDS HELD BY IMPERIAL BANK

Building Account		
Canada Permanent Debentures	L 13275	$ 500.00
	L 15591	500.00
	L 15592	500.00
	L 3754	500.00
Dominion of Canada	T E 18682	1,000.00
Life Membership Account		
Canada Permanent Deb.	L 3892	100.00
Southam Press Fund		
1931 Dominion of Canada Service Loan 5%		
	N1 A 78148	100.00
	A 78149	100.00
	A 78150	100.00
	N2 E 75930	1,000.00
Amount Due from General Account		67.10

(Signed) J. H. Horning,
General Treasurer.

Audited and found correct
January 15, 1932
John B. Fraser,
A. R. Hassard, } *Auditors.*

OTTAWA TREASURER'S REPORT

I beg to submit herewith the report of the Society for the current year 1931.

Of the 64 members 4 are life members, 8 owe dues for 1931, 9 for 1930 and 1931, 3 for 1929, 1930, and 1931 and 1 for 4 years.

The amount of dues collected during the year was $107. The sum of $106 was sent to Head Office in January but up to the present no contribution has been returned.

The greatest expenditure was for expenses of lecturers, amounting to $46.95. The statement of finance is as follows:

Balance in Bank on December 19, 1930	$192.35	
Dues collected during the year	107.00	
Interest on deposits	2.01	
		$301.36
Amount sent to Toronto Head Office	$106.00	
Expenses of lecturers	46.95	
Printing, postage, advertising, etc.	27.11	
		$180.06
Leaving a balance in bank on December 18, 1931		$121.30

Audited and found correct,

D. B. NUGENT,
Auditor.

A. W. GRANT,
Treasurer.

MONTREAL TREASURER'S REPORT

RECEIPTS

Balance brought forward	$271.18	
Membership Fees (114)		
1929— 1 fee		
1930—16 fees		
1931—95 "		
1932— 2 "	228.00	
Bank Interest	11.07	
Grant from General Treasurer	105.50	
Donations to Montreal Centre	26.00	
		$641.75

EXPENDITURES

Meetings—Janitor, Lantern, etc.	$ 20.75	
Lectures—Travelling Expenses, Dinners, Taxis, etc.	58.80	
Secretarial—Stamps, Stationary, Telegrams, etc.	21.75	
Press Advertisements	4.75	
Exchange on Cheques	.25	
Remitted to General Treasurer (114 Fees)	228.00	
		$334.30
Balance in Bank		307.45
		$641.75

Audited and found correct.
October 19, 1931.
W. E. LYMAN

A. VIBERT DOUGLAS,
Treasurer

WINNIPEG TREASURER'S REPORT

RECEIPTS

Balance Statement of 1930		$104.82
Grant from General Treasurer	$ 31.50	
Bank Interest	2.14	
Subscriptions to December 9th, 1931, as follows:		
11 Members' Dues—1930	22.00	
40 " " —1931	80.00	
4 " " —1932	8.00	
Cash Receipts	.25	
		143.89
		$248.71

DISBURSEMENTS

Advertising	$ 32.01	
Printing	15.91	
Operation of Lantern	8.00	
Honorarium	6.50	
Ft. Garry Hotel (Dr. Plasket)	9.15	
Banquet (Dr. Plasket)	8.25	
Bank Exchange	.51	
Postage	9.83	
Telegram	1.70	
Flowers	14.50	
Cheque to Toronto Centre	94.00	
		$200.36
Balance in Bank, December 9th, 1931		48.35
		$248.71

Audited and found correct,
December 9th, 1931.
(Signed) JAMES HOUSTON
MRS. E. L. TAYLOR } *Auditors.*

J. H. KOLB,
Treasurer.

LONDON TREASURER'S REPORT

Receipts

Balance Statement of 1930		$117.73
Grant from General Treasurer	$ 53.00	
Fees for 1931	141.00	
Fees for 1932	4.00	
Bank Interest	4.21	
		202.21
		$319.94

Disbursements

Fees remitted to General Treasurer	$139.00	
Fees remitted to Treasurer, Toronto Centre	2.00	
Bank Exchange	.44	
Annual Meeting (12/12/30)	10.00	
Annual Picnic	4.45	
Dinner (30/10/31)	4.50	
Honorarium, Mr. G. Fitchett, Normal School	2.00	
Honorarium, Mr. H. Billings, London Life Bldg.	5.00	
Flowers	1.25	
Telescope Transportation	4.50	
Secretary's Supplies	2.35	
Stamps, Envelopes, Meeting Notices	32.23	
		$207.72
Balance in Bank, December 11, 1931		112.22
Stamps on hand		5.15
Total Assets, December 11, 1931		$117.37

G. R. Magee,
Treasurer.

Audited and found correct,
December 11, 1931.

(Signed) E. H. Anundson
W. L. Prior
Auditors.

VICTORIA TREASURER'S REPORT

Receipts

Balance in hand	$ 27.28
Membership Fees	185.00
Grant from Parent Society	98.00
Bank Interest	1.50
	$311.78

Expenditures

Remittance to Parent Society (membership fees, 1930)	$203.00
Advertising	36.51
Printing	21.84
Janitor	20.00
Postage	13.39
Expenses of Lecturer	4.00
Sundries	2.57
	$301.31
Balance in hand	10.47
	$311.78

P. H. Hughes,
Treasurer.

Audited and found correct,

W. T. Bridge,
Auditor.

LEARNED SOCIETIES FOR THE UNLEARNED*

By J. S. Lane

MY intimate friends, I may say my candid friends, sometimes ask me what I am doing in the Royal Astronomical Society and one or two other societies of a similar character to which I have the honour and privilege to belong. More especially I have been asked how it is that I occupy at present the position of President of the Ottawa Centre of the Royal Astronomical Society of Canada, a position that is wont to be filled by a real astronomer, and which has been occupied by many such men. With regard to this second question I can only say that it seems to indicate that the Society is of the same opinion as myself, viz., that there is room in Learned Societies for unlearned men.

May I take this opportunity, the first that I have had, to thank the members of the society for the great honour they have done me in electing me to this position which has been filled by so many distinguished predecessors? It is the highest honour that has ever been bestowed upon me by any body of scientific men, and an honour that I appreciate very much indeed. I wish also to convey my thanks especially to the Hon. Pres., Mr. Smith, and the Vice-Pres., Mr. Madill, who discharged the duties of the presidential office during the past season, when I was unable on account of ill-health to undertake them myself.

In reply to the first question, why I seek membership in such societies as ours, and why I attend their meetings as faithfully as possible, I would say that it is because scientific matters have a real interest for me even when they pass my comprehension, and that I live in hope that what I know not now I may know hereafter.

By learned societies I understand institutions whose members are united in some common interest of a scientific nature; referring to science in the broad meaning of the word, not limited to the

*Presidential address to the Ottawa Centre of the R.A.S.C., October 23, 1931.

natural or physical sciences. These societies are organized to stimulate their members mutually in pursuing research along some definite line, and very commonly they encourage this research by holding meetings, carrying on discussions and issuing publications relating to their work. By the unlearned I mean people who are not equipped with the special technical knowledge, training and skill which would be necessary to enable them to help advance the progress of knowledge along these special lines, but who have sufficient intelligence and education to understand and appreciate the work that is being done by the experts.

Of course, there are people who are scarcely qualified to do even this. Mistral, the Provençal poet, tells us in one of his amusing stories, about a market gardener who had no faith in astronomy, as he could not believe that anyone had ever been able to measure the distance from the earth to the moon, but he believed fully in a "real science of the moon", according to which he cultivated his vegetables and carried on his gardening operations in general.

I once had a similar experience myself. I had undertaken to explain to an old lady how it was that under certain circumstances we always saw a rainbow. I did my best to make the matter clear, drew a little diagram to illustrate the refraction and reflection in a drop of water, etc., and I thought that my pupil, who listened attentively, was understanding the matter very nicely, but when I got through she said: "Oh! how could anybody get up there to see?"

Such people would not derive much benefit from the proceedings of any learned society, but I wish to speak for, and to make an appeal to, persons who are not engaged professionally in scientific pursuits, who have not, for instance, the training in mathematics which is necessary for the astronomer by vocation, but who have intelligence and education enough to understand scientific subjects when presented in an untechnical way; men and women who desire and are quite competent not only to know the results obtained by men of science, but to understand the principles and methods upon which these results depend, without having the time and patience, perhaps even without having the ability to master all the details of the investigations. May I be permitted to point out a couple of

notable examples from the history of what I consider the most illustrious of all Learned Societies. No doubt a German or a Frenchman would not agree with me when I claim this honour for the Royal Society of London, but probably none of us here will dispute the claim. Among its first members was Prince Rupert, a soldier of some mark and an exemplar of the Cavalier virtues and vices of his time, but certainly not exactly what we would call a scientist, although he was distinguished by a taste for random experimentation which has left us those tear-shaped morsels of glass, at once so resisting and so fragile, known as Prince Rupert's Drops.

Another of the earliest members of the Royal Society was Samuel Pepys, the immortal diarist. Pepys was one of the ablest administrators that the British Navy has ever had, and his avocations were numerous, but he appears to have devoted most of his leisure to music and women. I may be permitted to remind you that to the ancients the name Urania had a double significance; it was not only the name of the muse who presided over the study of the stars and inspired the astronomer, but was also an appellation of Venus, the goddess of Love. One might have expected Pepys' Urania to be the goddess rather than the muse, but nevertheless we find him in 1686 occupying the position of president of the Royal Society, what I would call the proudest position in the world of science. It was under the *imprimatur* of S. Pepys as president of the Royal Society that the most notable of all its publications appeared; I refer to Newton's Principia.

So you see that there are precedents for the presumption of a layman who accepts high office in a learned society.

The intelligent but non-scientific people of whom and for whom I am speaking will usually be found willing to accept conclusions upon which professional men of science are in general agreement, notwithstanding the fact that Tennessee is not the only part of the modern world where ancient and inherited prejudice is sometimes stronger than the desire to follow where knowledge may lead us: *Quo ducit Urania*, to quote our motto. It is a strange thing that there should be such men as the late W. J. Bryan, men of unquestionable

ability in many ways, who are yet adamant to proof where prejudice is concerned. A notable example of another eminent lawyer and politician occurs to me, a Briton this one. Lord Brougham's attacks upon Thomas Young and his wave theory of light delayed the acceptance of this theory until the time of Fresnel. Brougham was no physicist but the power of his invective and the prestige of the review in which he wrote were such that the merits of the case were overlooked, and Young's reply to the attack went almost unnoticed. Brougham based himself merely upon a few great names, in particular upon that of Newton, quite forgetful that Newton would probably have been among the first to appreciate Young's reasoning. One wonders what ground Brougham would occupy nowadays, when the physicists can scarcely tell us what is a wave and what is a corpuscle.

I hope that the popularization of science will never imbue amateurs with the idea that they know more about these abstruse subjects than do men of the greatest ability who have devoted their lives to scientific studies, but I hope that intercourse with men who really know what they are talking about, as far as their subject is known at present, will teach us outsiders not only the rudiments of the science concerned, but also humility and modesty.

At the present time, of course, there is a revolution going on, or, at least, revolutionary ideas are being advanced in what were considered the most exact sciences, that leave the amateur aghast in wonderment, and even the ablest of professed and professional men of science are not in agreement. Thus Sir Oliver Lodge, clinging as best he may to what we may call the old, or classic, school of physics, is compelled to admit that Einstein's equations solve certain outstanding difficulties in a remarkable way.

Einstein constructs a space-time continuum in which space is limited but time is infinite, and thus we get a cylindrical conception of unlimited length with time as the axis of the cylinder. The result appears to be that the movements of material particles and, therefore, of events are to be represented by vertical lines on the surface of the cylinder and world-lines (*i.e.*, those traversing the shortest possible distance from point to point) are spirals running

around the cylinder at an inclination of 45°. Hence it follows that just as often as a world-line makes the tour of the cylinder, *i.e.*, in the time that light takes to travel around the curved and limited space (I believe that about 408,000,000,000,000 years is the result of Hubble's calculations) the world-line intersects the time-line again and the event is repeated. It reminds one of the warrant officer in one of Marryat's novels, who had worked out a semi-philosophical, semi-scriptural scheme by which he proved that everything happened over and over again, only he set a modest limit of some 16,000 years to his cycle.

De Sitter, however, one of the few men who understand the space-time continuum, does not like this idea of endless repetitions (it might become monotonous after a while) and he proposes to substitute for the cylinder a hyperboloid or rather one side or one sheet of a hyperboloid, the rectilinear generating lines of which are inclined at an angle of 45° to the perpendicular. According to this plan the distance of particles from each other increases with the progress of time, that is to say, things are getting farther apart, the universe is expanding. Certain spectroscopic observations of the most distant nebulae show a shift of lines towards the red that would indicate an enormous velocity away from us, away from everything that we know. This has been held to be a confirmation of de Sitter's scheme.

What does it all mean? Sometimes when one broods long enough over these theories one begins to believe that they mean something real and are not just projections of equations, but in most moods one has a settled conviction that space is formed neither like a cylinder of infinite length nor like an infinite kettle drum. It is stated that the relations involved defy statement except in the form of very abstruse mathematical formulae, but, as I remarked before, it is the failure of the super mathematicians to agree that causes the layman to hesitate to accept the conclusions or opinions of any of them. Recently, only a few months before his death, Michelson was interviewed by a representative of the *New York Times*, who sought his opinion concerning the new theories. Michelson gave him the usual reply that the results of the mathematicians

could scarcely be interpreted except mathematically. The interviewer asked him if Prof. Eddington had not stated the matter in such a lucid way in his recent book that any intelligent man could understand it. Michelson replied that he had read the book in question and that there were things in it that he did not understand himself. If that was Michelson's position, what are the rest of us to do? There are other questions or new theories or conceptions that are quite as upsetting as any of the phases of the relativity doctrine, of which I have spoken because it is the best known of the new doctrines, *i.e.*, best known by name. Everybody has heard of it and the very knowledge of the name seems to give us a certain knowledge of the subject, as there is a tendency in our nature for us to think that we know something about a thing when we are familiar with even the bare definition of the name.

But it is just here that the learned societies, or perhaps I should rather say, what the learned societies represent, can help us. In speaking of modern developments in the theory of astronomical and physical science I have perhaps done it so clumsily as to convey the idea that no amateur could tell what to believe and what to disbelieve, and, of course, with regard to certain features of the new cosmology, a bit of sturdy agnosticism is a good thing; but we must always bear in mind that astronomy and its sister sciences have been for generations, and still remain, the most exact of all the sciences. It is likely that they will ever continue to occupy this position, and so we may confidently turn to astronomy either when we wish to strengthen our souls by the contemplation of knowledge earned to the highest degree of accuracy, or when we wish to refresh our imaginations by excursions into the romance of the worlds, for astronomy has a romance of its own that is not excelled by any other. Thus the poet Keats, when he wished to speak of the greatest emotion that a poetic mind could feel, likened himself to "some watcher of the skies when a new planet swims into his ken".

"Looking up at the stars" has ever been esteemed by people of sensibility as one of the greatest privileges and delights of life, and this is true whether we refer to the physical thrill that the sight of

the gleaming sky causes or whether we consider the "finer joy" that the intellect is in some manner capable of when it regards and partly comprehends the great framework of the world standing out against the abyss. "Oh! night, how sublime thou art" is the cry of the French poet; "on such a night" exclaims Lorenzo, and then again:

> There's not the smallest orb that thou behold'st
> But in his motion like an angel sings
> Still quiring to the young-eyed cherubims.

Tennyson watches the Pleiades, "gleaming like a swarm of fireflies tangled in a silver braid." By the way, when one considers that Tennyson wrote these lines before celestial photography had revealed the nebulous setting of the Pleiades one admires his inspiration all the more. To quote Shakespeare again:

> The poet's eye, in a fine frenzy rolling,
> Doth glance from Heaven to Earth, from Earth to Heaven;
> And, as imagination bodies forth
> The forms of things unseen, the poet's pen
> Turns them to shape and gives to airy nothing
> A local habitation and a name.

The scriptures declare that the heavens are telling the glory of God, and it is hard indeed for us to conceive any greater glory than that which they reveal.

I sometimes wonder what it would be like if we had a simplified astronomy, the simplest possible, as astronomy limited to the earth and the sun. In general terms we are apt to speak of the heavens and the earth, but we must not forget that although the division just mentioned is a natural and at times a convenient one, the earth is a denizen of the skies, one of the starry spheres, and that it belongs to astronomy just as much as any other of the planets.

Let us suppose, then, that the universe, as far as known to mankind, is limited to two heavenly bodies, the sun and the earth, the two which are of supreme and necessary interest to our existence here. There is nothing in this supposition, I apprehend, to preclude the development and evolution of man upon the earth just as this evolution and development have taken place, with the exception of the stimulation of his poetical and intellectual faculties

which the contemplation of the sky and the study of astronomy have lent them, and, after all, as Robert Louis Stevenson reminds us, "the world is so full of a number of things" that poetic faculty and intellectual vigour may well thrive even without the inspiration of Urania.

I wish that some one of the members of our society who is mathematically competent to deal with the question would tell us sometime, just how much astronomy and mathematical geography might be expected to be known under the circumstances postulated. It does not occur to me that there would necessarily be any great changes in the physical features of the earth from what we know now, other than such as would be caused by the absence of the lunar tides, both in the oceans and in the solider portions of the earth. In the course of astronomical time this would doubtless greatly modify the geographical features of the globe, but, I take it, the differences would be in detail, and would not affect the suitability of our planet as an abode of life. The sun would doubtless be practically as it is, a little larger, perhaps a little hotter, on account of all the planets except the earth still forming a part of it, but I must suppose it to be quite unaffected by the absence of other stars.

What would our astronomy be under such circumstances?

The changing seasons would have driven the mind of man to inquire the cause of the changes, and he would no doubt have discovered the inclination of the earth's axis, and perhaps the ellipticity of its orbit, but probably he would have been able to fix no close limits of accuracy to his conclusions on account of the lack of opportunities for accurate observation. The same applies, of course, to such questions as the size of the sun and hence its distance, its heat, etc. Could he infer the heat, and from that the distance and other elements from spectroscopic or thermometric observations? These are doubtless questions which might be answered by practical astronomers, but probably they would tell me that they have something better to do, that they accept the universe as it is, and are mainly concerned in finding out *how* it is. As far as speculative matters are touched upon by them in formulating hypotheses

to explain the development of the universe as they find it, and perhaps to look forward through millions of eons to hazard a guess as to what it may become or what may become of it, they allow their imaginations a wider scope.

"Whence and oh, heavens, whither?" exclaims Carlyle. Carlyle, of course, was no astronomer. Far from it; at times we find him uttering, very carelessly, no doubt, statements that are quite contradictory of the received facts of astronomy. For instance, on one occasion he remarks in his dogmatic, irresponsible way: "Thou fool! Dost thou not know that when thou castest a stone out of thy hand thou changest the centre of gravity of the universe?"

And yet, I suppose, among all the "conservations" so dear to physical science there is none to which she would cling more firmly than to the conservation of the centre of gravity of the universe.

But to come back to Carlyle's question "whence?"

Man has long, one might perhaps say always, sought to give an answer to this question. Primitive and ignorant races have given various replies, generally of a very anthropomorphic and clumsy kind. The early cosmogonies of the oriental peoples were of a more imaginative type, and the ancient Greeks developed a dynasty of creative gods who wrought during several generations to produce man, after having brought forth a world in which he might live.

Some half dozen centuries before the Christian era the Greek philosophers rejected their old mythology with its cosmogony, but anything that they had to put in its place was not very satisfactory.

Indeed, it is not until the time of Newton that we find any theory advanced that would appeal at all to the present age. Newton expressed the idea that in a limited space uniformly filled with matter in a very diffuse form, but endowed with gravitational energy, this matter would condense into a sun, and that in an infinite space an unlimited number of suns or stars might be thus formed.

Kant, the German philosopher, evolved something very close to the nebular hypothesis of Laplace. Indeed Laplace's "Celestial Mechanics" has been called "Kant's theory with the mistakes left out." However, it seems probable that Laplace was quite ignorant of Kant's hypothesis, which remained hidden among his philosophical

writings. As the "Nebular Hypothesis" held the field almost throughout the nineteenth century we will give a short sketch of it.

Laplace imagines, as Newton and Kant had done before him, a huge, nebulous mass of matter pervading all space. This idea was common to the poets as well as men of science. Hesiod, Dante and Milton had all expressed something like it. May I quote a few lines from the last:

> A hoary deep, a dark
> Illimitable ocean, without bound,
> Without dimension, where length, breadth and height,
> And time and place are lost.
> . . . . A wild abyss,
> The womb of Nature, and perhaps her grave.

What was the origin of this matter? Was it Creative Thought become matter as the Word was made flesh, or was it primordial, subsisting from everlasting to everlasting? Laplace does not know and does not claim to know. He postulates it and endows it with gravitational force and a moment of rotation. The rest follows logically from mathematical reasoning. The nebulous matter condenses here and there into more swiftly rotating masses which would be spherical, but for their rotation, and which become ever more intensely heated as they shrink, and at the same time spin ever more rapidly, until, at length, the suns throw off planets and the planets satellites, and we have solar systems such as the one of which we form a part. Tennyson puts it very briefly in "The Princess":

> This world was once a fluid haze of light,
> Till toward the centre set the starry tides,
> And eddied into suns, that wheeling cast
> The planets.

For a long time this theory seemed to explain everything except a few minor points, such as the retrograde motion of certain satellites, but it was finally recognized that it was incompatible with both mathematical theory and observational astronomy. Before a sun cast a planet it would have to assume the form not of a spheroid, but of a double convex lens, nor would the matter be

cast off in such quantities as to produce planets, but in a stream of particles, just as a revolving wheel casts spatters rather than shovelfuls of mud. And the binaries as they "muster in their myriads", nay, in their millions, in the sky proclaim the fate that awaits the star that whirls all too wildly in the cosmic waltz: it is not to procreate a family of planets but to become a separated couple, drifting ever farther apart under the influence of transient and distant attractions.

In short, it is recognized now that Laplace's scheme cannot explain the origin of our system, although it may apply elsewhere in the universe and possibly something very like it holds good in the formation of suns in the outer regions of the spiral nebulae. It is not a question of principle but of degree, or of size.

The theory which is most favoured at present in the tidal theory. It is calculated that if two suns should chance to pass sufficiently close to each other—within some half dozen radii—tides of a disruptive force would be generated, and that the matter thus thrown off from the parent suns would form not only the planets, but everything else that we recognize as belonging to our system, including asteroids, the matter of Saturn's rings, meteorites and so on right down to the tails of the comets and the still more tenuous matter, the last vestiges of which are perhaps revealed to us by the zodiacal light.

One of the most important differences between the nebular hypothesis and the tidal theory is that, according to the former, we might expect most, if not all, of the suns to be accompanied by planets, according to the latter only about one in a hundred million would have this dignity.

So much for the "whence?" Now, in conclusion, a word as to the "whither." Is the universe to run down to a lifeless mass of uniform temperature and energy as the doctrine of the dissipation of energy used to teach, or does it contain within itself some power of regeneration that will enable it to arise, phoenix-like, from its burned out ashes, and renew its youth like the eagle. I have always felt that, if it were destined for an end, it would already have reached that end, having an infinity of time behind it as well as

before it. Some of my metaphysical friends tell me that my reasoning is not sound. I do not know. I can only assert my right to postulate. Very recent discoveries by Millikan and others with regard to the cosmic rays seem to point to the evolution, somewhere in space, of more complex atoms from hydrogen, thus liberating a store of energy, proportional to the mass that vanishes, and I can but believe that there is a vast balance in the universe and that it will be eternally preserved. These are things that we do not know, that possibly we shall never know, and fascinating as it may be to endeavour to see a little farther into the darkness that surrounds us it would be presumption to state that any gleam that may have reached us is the perfect light. Shall we exclaim with Victor Hugo, as he contemplates the starry night from the sea shore: "C'est le Seigneur, le Seigneur Dieu", or shall we say with Du Bois-Reymond, "Ignorabimus"?

For myself may I be permitted to quote, in closing, a few lines from Wordsworth:

> I have felt
> A presence that disturbs me with the joy
> Of elevated thoughts; a sense sublime
> Of something far more deeply interfused,
> Whose dwelling is the light of setting suns
> And the round ocean and the living air
> And the blue sky and in the heart of man;
> A motion and a spirit that impels
> All thinking things, all objects of all thought,
> And rolls through all things.

REVIEW OF PUBLICATIONS

Textbook of Practical Astronomy, by Jason John Nassau, Professor of Astronomy in the Case School of Applied Science. 226 pages, 5½×9 in. N.Y., McGraw-Hill, 1932. Price, $3.00.

This book is intended for students who have had no work in astronomy but desire to take an elementary course in practical astronomy. The general astronomical ideas are covered in the first chapter and the subsequent chapters deal with systems of coordinates, time, changes in star positions, corrections to observations, instruments, latitude, azimuth, longitude, the zenith telescope. The student is supposed to have an elementary knowledge of spherical trigonometry. The book is printed on good durable paper and is clearly printed. There is a useful set of tables at the back and a set of blank computation sheets to instruct the beginner how to arrange his computations. It should prove a very good book for the engineering student for whom it is intended. In places it is rather elementary. In obtaining the declination of the sun from the ephemeris, the variation per hour is used nearest the epoch of the observation. Students who are capable of doing intelligent work in practical astronomy might be shown the correct way of using the rate of variation for interpolation. R. K. Y.

The Universe, from Crystal Spheres to Relativity, by Frank Allen, Professor of Physics in the University of Manitoba. 146 pages, 5×7½ in. Lond.: Ivor Nicholson and Watson, 1931. Price five shillings.

The title of this book would suggest the transition from necromancy to reality. Within its covers one finds the portrayal, in simple but fascinating narrative, of the evolution in the concept of the structure of the universe from the once apparently satisfying Ptolemaic crystal sphere system to the elusively interwoven fabric of mass, space and time, now almost a sacred and at least superstitiously satisfying system associated with the term "relativity." Many an author has essayed to delineate the magnificently comprehensive Einsteinian structure for those who lack intimate knowledge

of the details of composition and forms in its creation; but few have been successful in their mission. For the average reader the outline has been but dim and hazy, and at best has inspired a yearning for a clearer view. In Professor Allen's little book the story is presented in plain historical sequence and in language and picture so simple and clear that to the reader Relativity becomes indeed a Universe. The book is published in very attractive form.

L. GILCHRIST.

Les Étoiles dans leus Courses, by Sir James Jeans. 205 pages. 5½×7¾ in., 46 plates and 2 star charts. Paris, Hermann, 1932. Price (paper), 35 frs.

This is a French edition of "The Stars in their Courses," which was reviewed in these columns some months ago. The translation is by A. Sallin and it is clear, straightforward and simple. The half-tone plates are exceptionally well done, the paper is superior and the printing excellent; indeed the book is pleasing to look at and to read. This edition will undoubtedly have a large circulation. The present writer thinks an indication of the sources of the illustrations would have added to the completeness of the book as well as to the general interest. C. A .C.

A. PÉRARD, La haute précision des mesures de longueur au laboratoire et dans l'industrie.

P. AUGER, L'effet photo-électrique des rayons X dans le gaz.

F. PERRIN, Fluorescence durée élémentaire d'emission lumineuse.

M. DE BROGLIE, Les récents progrés désintégration artificielle des éléments par bombardiment de rayons alpha.

J. J. TRILLAT, Les applications des rayons X a l'étude des composés organiques.

J. J. TRILLAT, L'état liquide et les états mésomorphes.

P. LE CORBEILLER, Les systèmes autoentretenus et les oscillations de relaxation.

E. DARMOIS, L'hydrogène est un mélange ortho et parahydrogène.

R. AUDUBERT, Les piles sensible a l'action de la lumière.

The above are reports of lectures given at the Conservatoire national des Arts et Métiers in Paris during 1931. Each is an octavo pamphlet of from 25 to 50 pages, with numerous diagrams and some plates. The authors are eminent French scientists and

they treat their subjects in an authoritative manner. The lectures give a good summary of recent investigation and are very readable. Similar courses were given in 1929 and 1930. The prices are usually 5 frs., but two of the above are 8 frs. The publisher is Hermann in Paris. C. A. C.

NEWS AND COMMENTS

Director C. E. Kenneth Mees of the Research Laboratory of the Eastman Kodak Company, Rochester, presented a second paper on "Photographic Plates for Use in Spectroscopy and Astronomy" at the meeting of the Optical Society of America, at Cambridge, Mass., February 25-27. An earlier paper on the subject appeared in the Journal of that Society for December, 1931, and this one will be published in the same periodical. These papers will be of special interest and importance to those making plans for photographic observations of the coming total solar eclipse of August 31.

Mr. A. H. Miller of the Dominion Observatory gave an address on February 6 at the Ontario Research Foundation building, Toronto, on the observatory's work on gravitational and magnetic methods of prospecting, begun in 1928. He dealt particularly with the work during 1931, in co-operation with the Research Foundation, in the Onakawana lignite field.

The McMath-Hurlbert Observatory at Lake Angelus, near Pontiac, Michigan, equipped with instruments for making motion pictures of the celestial bodies, was presented to the University of Michigan by three amateur astronomers, all honorary curators of the University of Michigan Observatories, Messrs. F. C. McMath, R. H. McMath and H. S. Hurlbert.

Victor Hugo on the size of the Sun's craters:

> "Silence au fond des cieux, planètes mes vassales!
> Paix! Je suis le pasteur, vous êtes le bétail.
> Comme deux chars de front passent sous un portail,
> Dans mon moindre volcan Saturne avec la Terre
> Entreraient sans toucher aux parois du cratère."

REDeL.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

Eclipse Chart in our last Issue

The chart on page 78 summarizing the probability of clear sky in Quebec at the time of the eclipse of August 31 next embodied information obtained from observations by the Dominion Meteorological Service. It was collected by Mr. A. J. Connor, climatologist, who also drew the original chart from which our drawing was made. This acknowledgment of indebtedness was inadvertently omitted.

Daylight Observations of Jupiter

Referring to Mr. Spurway's midday observations of Jupiter recorded in the Journal for December, Mr. Oscar Whittaker, of Hollyburn, B.C., writes:—"I have frequently seen Jupiter with the naked eye while the sun was yet shining in the west. The best time to do this is when Jupiter is not too high in the sky at the time of sunset. The planet can easily be picked up one evening very soon after the sun sets and its position be noted with reference to some terrestrial object—a tree or a chimney, say—and on following evenings it may be looked for twenty or thirty minutes before the sun sets, making allowance, of course, for its diurnal motion.

Mr. Whittaker also recalls an interesting group of celestial objects at 8 p.m., April 30, 1930. It included the crescent moon, Jupiter, Venus, Mercury and Aldebaran, all arranged in symmetrical pattern such as is of very rare occurrence.

A Brilliant Meteor in Manitoba

Mr. G. P. Morse, of Winnipeg, reports a bright meteor seen at Winnipegosis on January 26, 1932, at 8.25 p.m. C.S.T. Looking towards the south east, the path of the meteor began just to the right of Sirius, extended downwards and slightly to the right, and disappeared after traversing about 8° on the sky. Maximum brightness was attained when about through three-fifths of its apparent course.

C. A. C.

MEETINGS OF THE SOCIETY

At Winnipeg

At the annual meeting the officers for 1932 were elected as follows:—

President: Dr. Neil John MacLean.

Vice-President: A. W. Megget.

Treasurer: J. H. Kolb.

Secretary: Mrs. J. Norris.

Council: D. R. P. Coats, James Houston, Prof. V. W. Jackson, Rt. Rev. T. W. Morton, Mrs. H. M. Sweet, Mrs. E. L. Taylor, A. V. Thomas, L. A. H. Warren.

Programme Committee: Dr. N. J. MacLean, A. W. Megget, Mrs. E. L. Taylor, Mrs. J. Norris.

Auditors: James Houston, Mrs. E. L. Taylor.

S. C. Norris, *Secretary.*

At Hamilton

December 16, 1931.—The regular monthly meeting was held at 8.15 p.m. in the Public Library Lecture Hall.

This being the annual meeting of the Society, several reports of committees were read and approved and the financial report of the treasurer was passed on to the council for approval after auditing. Mr. T. H. Wingham and Mr. G. C. Campbell were appointed auditors.

J. A. Marsh, retiring president, thanked the Society and council for the splendid co-operation given him throughout the past two years, after which the election of officers for 1932 took place as follows:—

Hon. President: Rev. Dr. Marsh.

President: Wilfrid S. Mallory, M.A.

Vice-Presidents: T. H. Wingham, B.Sc.; Rev. John Samuel; Professor Wm. Findlay.

Secretary-Treasurer: Geo. E. Campbell.

Curator: Hugh Rodger.

Council: Miss W. Parker; Miss A. B. Marsh; W. T. Goddard, B.Sc., E.E.; W. G. Milne, A.M.E.I.C.; Dr. Gordon M. Jackson; J. A. Little; S. C. Scammell; Wm. Hodgson; Dr. W. R. Jaffrey.

Following the business meeting, Mr. T. H. Wingham spoke on "Diagrams" and drew interesting charts of the double star Algol showing its light variation and also a chart showing a star of the Cephied type and how the curve was arrived at.

"How to determine the Approach and Recession of a Star by means of the Spectroscope" was the subject of a study hour conducted by Mr. W. S.

Mallory, who took his audience through the intricacies of the light waves of the spectrum. All light rays of the spectrum travel in free space at the same speed, with the red waves at one end of the spectrum being longest in wave and the violet at the other end of the spectrum being the shortest. The speaker then showed how the shift in the lines of the spectrum revealed whether a star was coming toward or going away from us.

January 12, 1932.—The regular monthly meeting was held in the usual place at 8.15 p.m.

Mr. T. H. Wingham gave a short address on the Heavens for January. He told us where to look for the planets Venus and Jupiter, and pointed out the difference in the variations of Algol a double star, and the variations of Mira which seems to swell and contract.

Mr. J. S. Taylor of Richwood introduced the speaker of the evening, Rev. Dr. Marsh, who chose as his subject "Our Sun."

He first spoke of the immense size of the sun and its different layers, consisting of the photosphere, chromosphere and corona. The variation in the number of sun spots over a length of time was noted and he explained them as being centres of great electrical disturbances, having an effect on compass needles and being associated with the Northern Lights.

A number of slides taken by Dr. Marsh's party during the eclipse of the sun in January 1925 were shown.

Dr. Marsh urged the Hamilton Centre to send a party to Quebec next August to photograph the eclipse which will be total near Montreal.

The Royal Astronomical Society of Canada

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Its objects are to study astronomy and cognate subjects, to publish the results of its work, and to maintain a library.

For many years the Toronto organization existed alone, but now the Society is national in extent, having active Centres in Montreal, P.Q.; Ottawa, Toronto, Hamilton and London, Ont.; Winnipeg, Man.; Victoria and Vancouver, B.C. Among its 800 members are a number of leading astronomers and scientists of the world, many amateurs, and, in addition, many laymen who are interested in the culture of the science.

The Society publishes a monthly JOURNAL containing each year about 500 pages of interesting articles and a yearly OBSERVER'S HANDBOOK of about 80 pages, containing valuable information for the amateur observer. Single copies of the JOURNAL or HANDBOOK are 25 cents.

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